Dam The Luck!

New Insights Into the Ecology, Evolution and Conservation of the Coyote Ceanothus (*Ceanothus ferrisiae*)

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Introduction

The endangered Coyote Ceanothus (*Ceanothus ferrisiae*; CEFE), a serpentine chaparral endemic, is known from only three populations in Santa Clara County, CA, USA. In order to mitigate impacts to the largest population of Coyote Ceanothus from a planned seismic retrofit of Anderson Dam, a new population must be created proactively. A potential mitigation site has been selected on Coyote Ridge, north of the reservoir, which is host to serpentine soils and associated rare species (Fig. 1). A series of collaborative research studies on the genetics, soil relationships, and water availability needs of known populations of Coyote Ceanothus were conducted to determine site feasibility and methods to create a successful, functioning population.

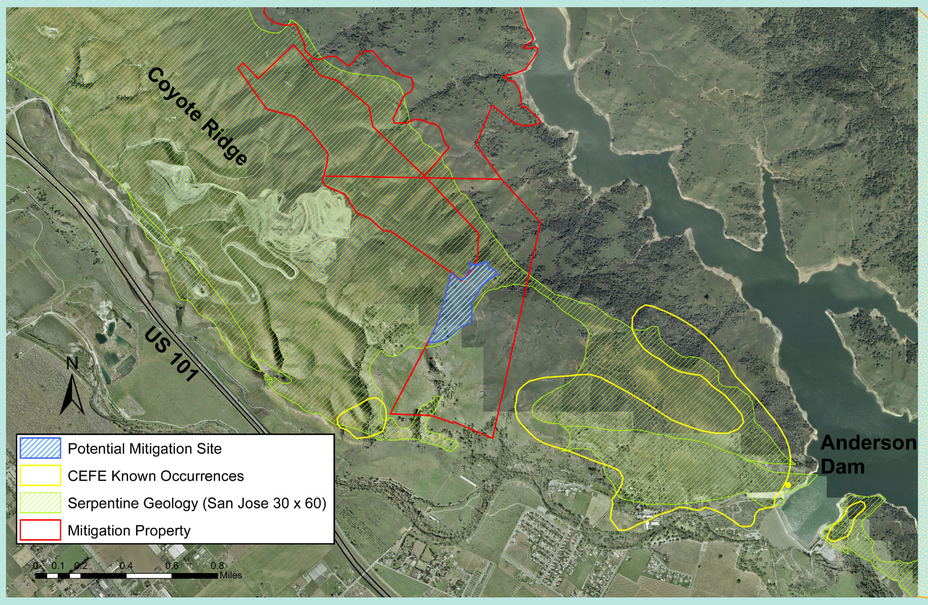


Fig 1. The potential mitigation site on Coyote Ridge, located 0.8 km equidistant between two of the three known populations of CEFE.



Results

Results of the plastid DNA and microsatellite work indicate that there are three putative populations and genetic variation is correlated with geographic location and distance among populations, with an east and west race likely (Fig. 2). Levels of genetic diversity differed among populations but were considerably low (Fig. 3). The late dry season water availability and microclimate suitability study indicates the introduction site is within the maritime climate envelope of existing populations (Fig. 4). Analysis of native soils in existing populations indicates that *Frankia*, an N-fixing soil actinomycete that associates with *Ceanothus*, is an important component of an introduction effort for a new population.

Plastid DNA Study- Patterns of Population Divergence

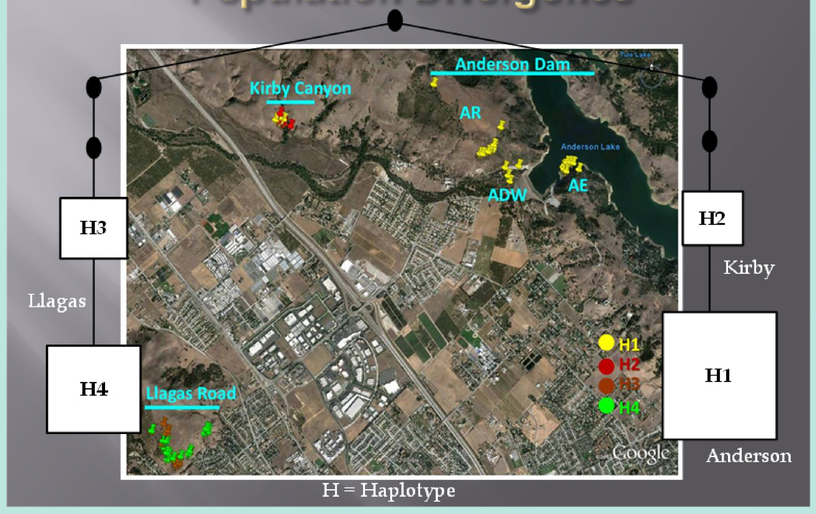


Fig 2. Four plastid DNA haplotypes were identified in CEFE. The three putative populations form 2 major groups, with Llagas variable and distinct from both Kirby and Anderson. Each line segment between boxes represents one mutation.

Microsatellite Study- Patterns of Genetic Variation

Sample Areas	Average A_L	Average P_A	Average Het_O	Average Het_E
ADE	5.1	7	0.46	0.51
ADW	5	1	0.43	0.50
AR	4.5	2	0.37	0.44
ARUB	5.1	3	0.40	0.46
KB	4.2	0	0.36	0.39
L	6	12	0.54	0.58

Average alleles per locus (A_L), private alleles (P_A), observed heterozygosity (Het_O), and expected heterozygosity (Het_E) for the six sample areas

Fig 3. Where ADE, ADW, AR, ARUB = Anderson; KB = Kirby; L = Llagas. Llagas had the highest overall levels of genetic variation, while Kirby had the lowest. These levels of genetic variation are considerably lower than that seen for other related species of *Ceanothus* in California.

Water Potentials Study- Comparative Drought Stress

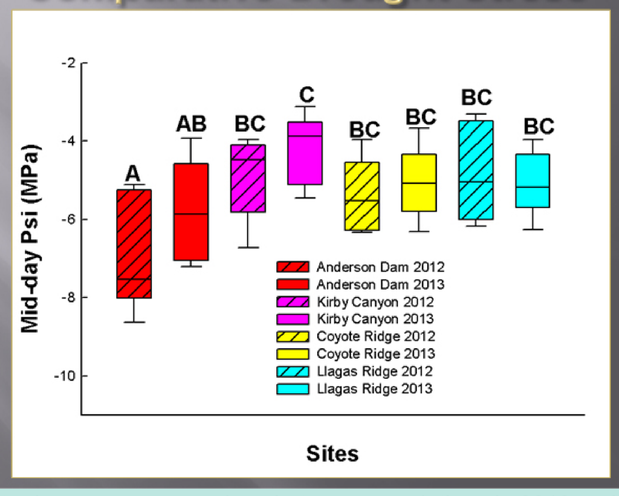


Fig 4. Late dry season comparison between populations in 2012 and 2013, where Psi_{min} = mean water potentials (n=10) for mature CEFE shrubs. Anderson Dam had the most negative water potentials while the Coyote Ridge subpopulation (adjacent proposed mitigation site) is within the range of other populations.







Conclusions

Considering these data, along with extensive field observations, we conclude that the candidate introduction site appears suitable. Test plots of Coyote Ceanothus seedlings were installed there in early 2014 and will be monitored for success for four years prior to a full-scale planting effort.

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